Modeling and Simulati
C4I:
Application and Implementation

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Dr. Gene Layman
Naval Research Laboratory
202 767-6873

Modeling and Simulation in C4I: Application and Implementation

- **Application:** Weapons of Mass Destruction Analysis (WMDA).

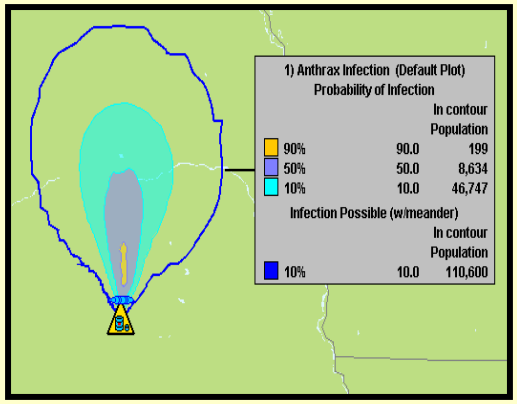
  Implementation: Embedded Simulation Infrastructure (ESI) Program.

Tactical Utility

WMDA Mission Application in C4I

Provide on-site situational awareness of nuclear, biological, and chemical **(NBC)** weapon information and processes that are beyond human cognition in “raw” state.

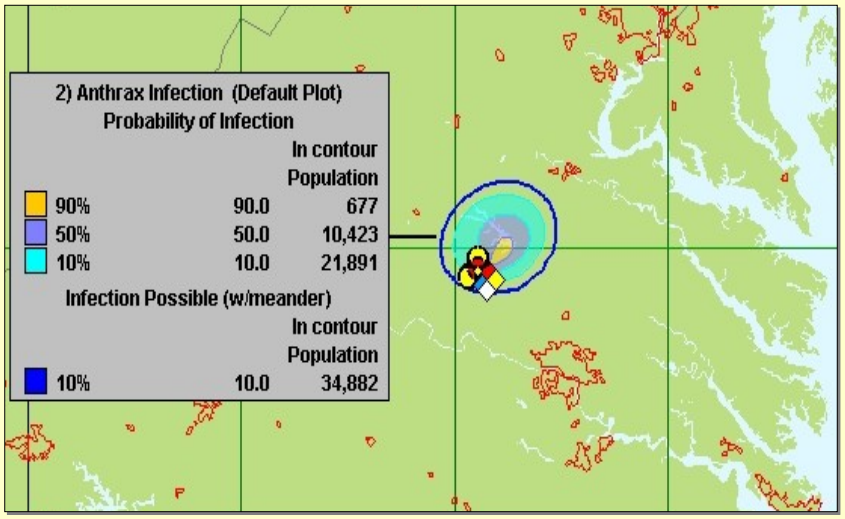
Predict and visualize the dispersal and hazardous effects associated with potential or occurring NBC attacks or from attacks on NBC facilities.



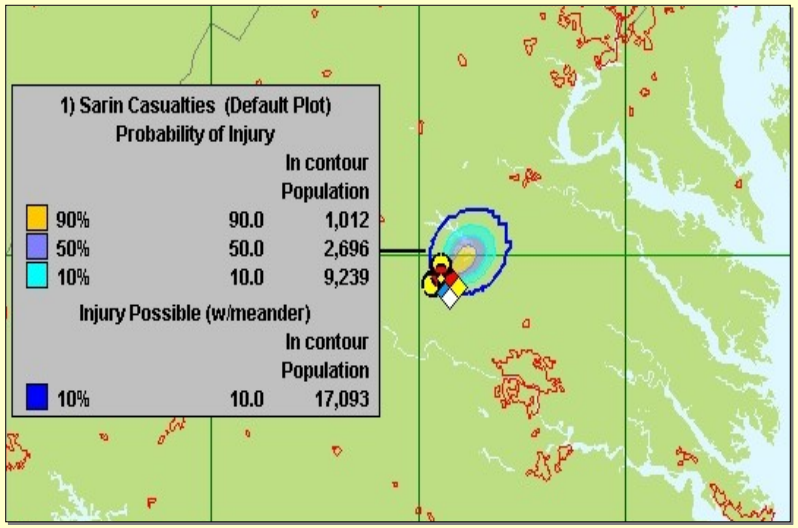
Weapon & Agent Type

Defense Threat Reduction Agency (DTRA) Models

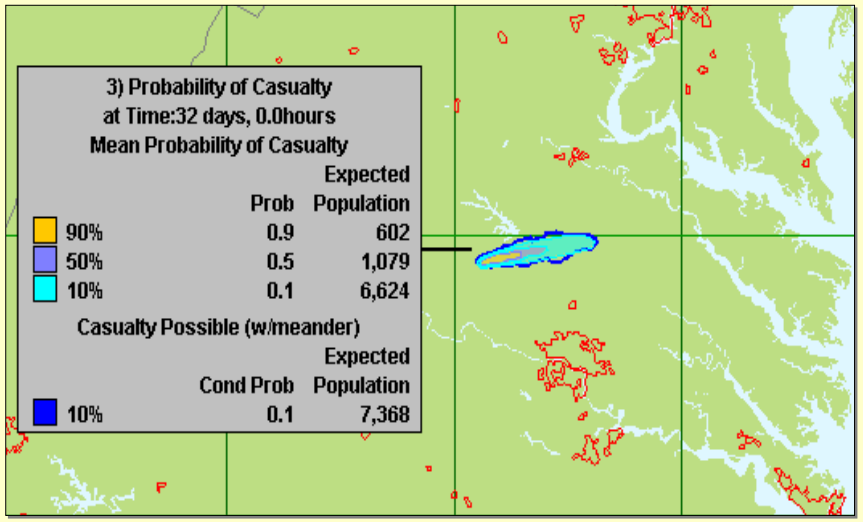
Biological
vs.
Chemical
vs. Nuclear



10 Kg Anthrax



10,000 Kg Sarin



10 KT U238

Operational Use

- Situation Assessment – Tactical, in-situ assessment of WMD effects & vulnerabilities.
- Planning Analysis - WMD effects & force protection.
  - Force disposition planning.
  - Strike planning for WMD secondary effects.

Functional Requirements

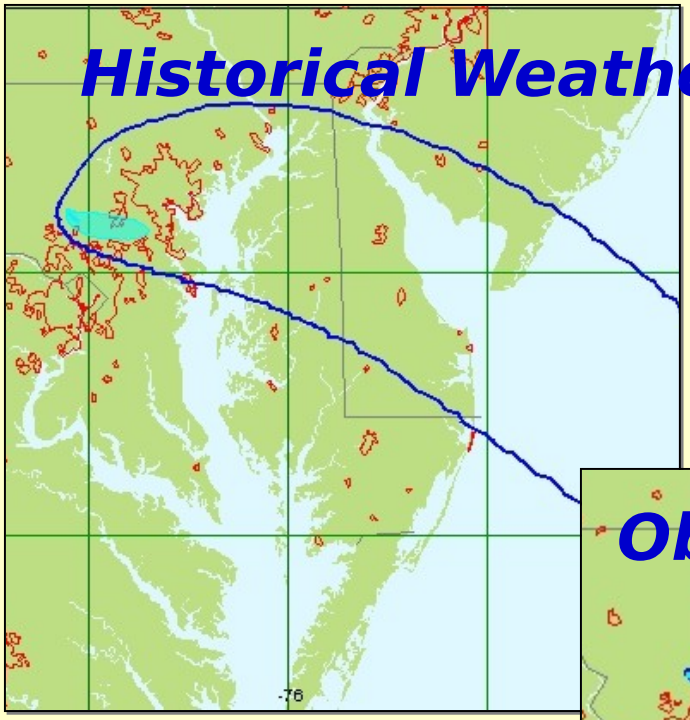
- **Estimate contamination, propagation and lethality. (Concentration contours & casualties).**
- **Operate with C4I tactical databases.**
  - **Timeliness - “live” information.**
  - **Using query/access methods used for real world ops.**
- **NBC information layered into operational picture.**
  - **Provide geo-spatial display & time projections for fallout/ contamination clouds vis-a-vis force movements and populations.**
- **Ability to interact with mission plans / operational scenarios / other C4I Mission Applications.**

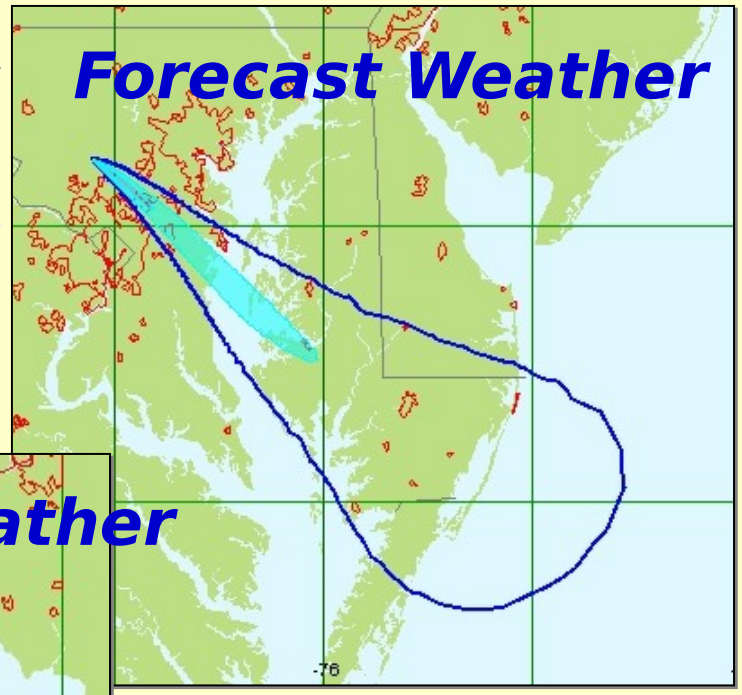
Analysis Requirements

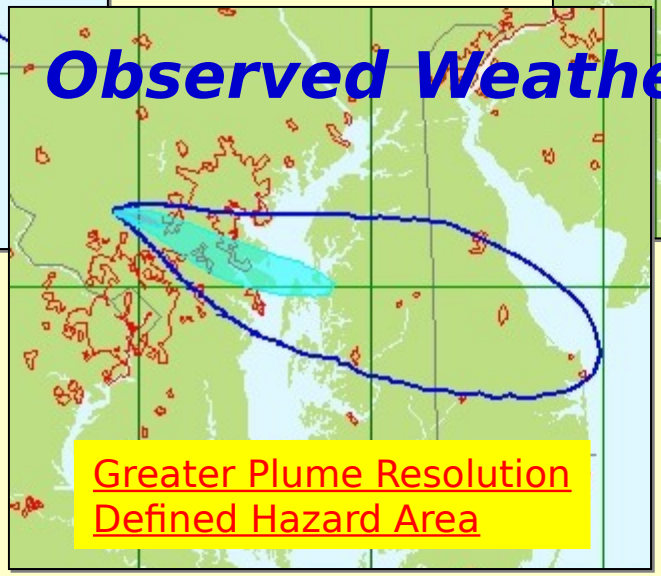
- Hazard sources & occurrences.
  - Chem/bio/nuclear weapons.
  - Attack on Chem/bio/nuclear facilities.
- Weather & transport.
  - Historical/forecast/observed weather.
  - Particle transport.
- Predict effects/uncertainties.
  - Identify contamination/hazard areas.
  - Calculate toxicity levels.
  - Estimate population/troop exposures.
  - Describe casualty & medical effects.

Weather Uncertainty

- ***Bio Facility***
- ***Moderate Damage***
- ***10 Kg Anthrax***







Historical Weather

- ***Large hazard areas***

Forecast/Observed Weather

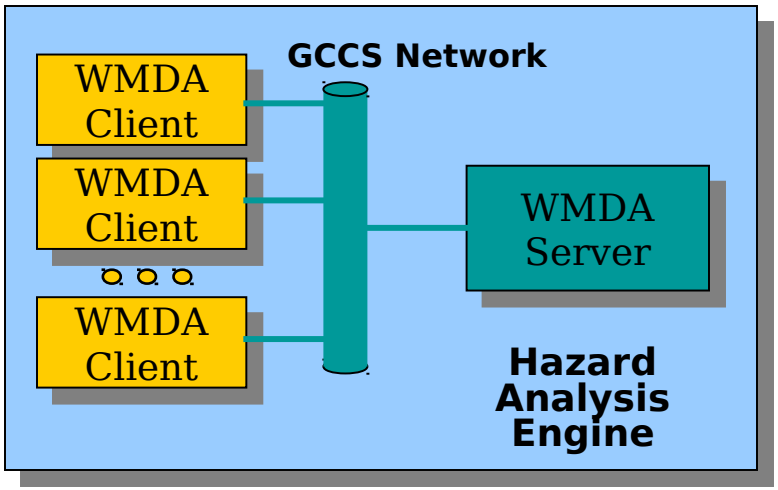
- ***Less uncertainty***

Note Scale Change.

Modeling and Simulation in C4I: Application and Implementation

Application: Weapons of Mass Destruction Analysis (WMDA).

- **Implementation:** Embedded Simulation Infrastructure (ESI) Technologies.



The Embedded Simulation Problem

C4I Systems were developed:

- To operate in real time with real world data.
- To present a single common operational picture.
- As global broadcast systems.

Simulations often operate in non-real-time, analyze “what if” situations and require local perceptions.

Embedded Simulation Infrastructure (ESI)

Program Goal

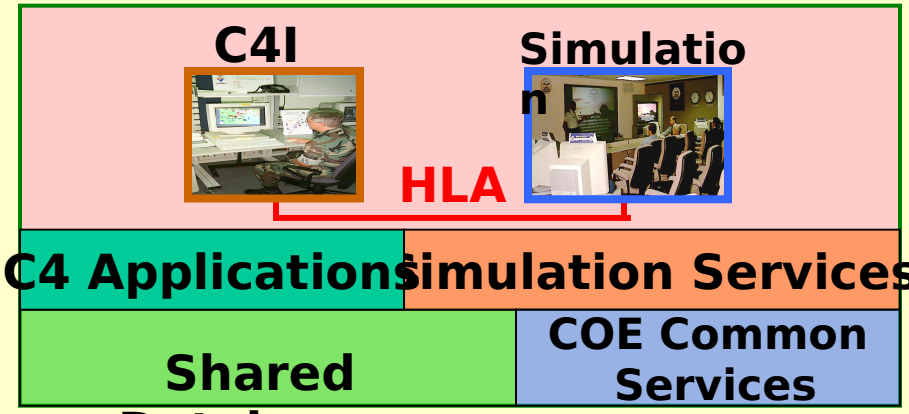
Create a **Modeling & Simulation Environment** in DII COE for development of simulation-based **Tactical Mission Applications***.

*** e.g., Tactical Decision Aids, COA Analysis, Situation Assessment,**
Mission Planning, etc.

Embedded Simulation Concept

Evolution from **Interfaces** to **Interoperability** to **Embedded Simulations**

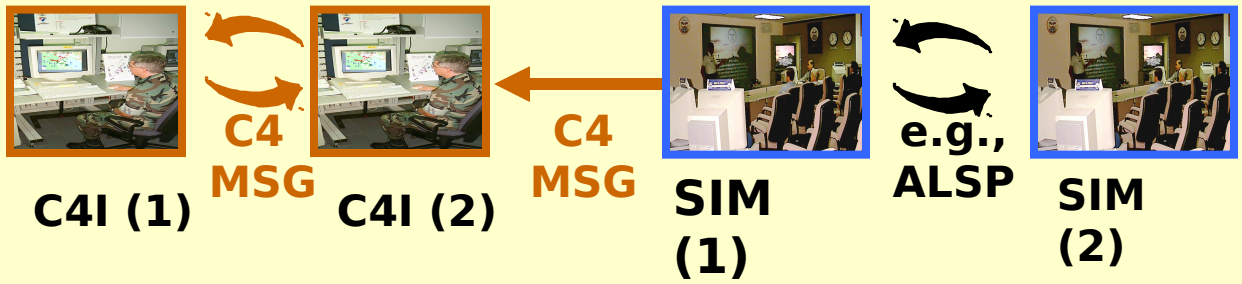
DII COE
(Embedded)



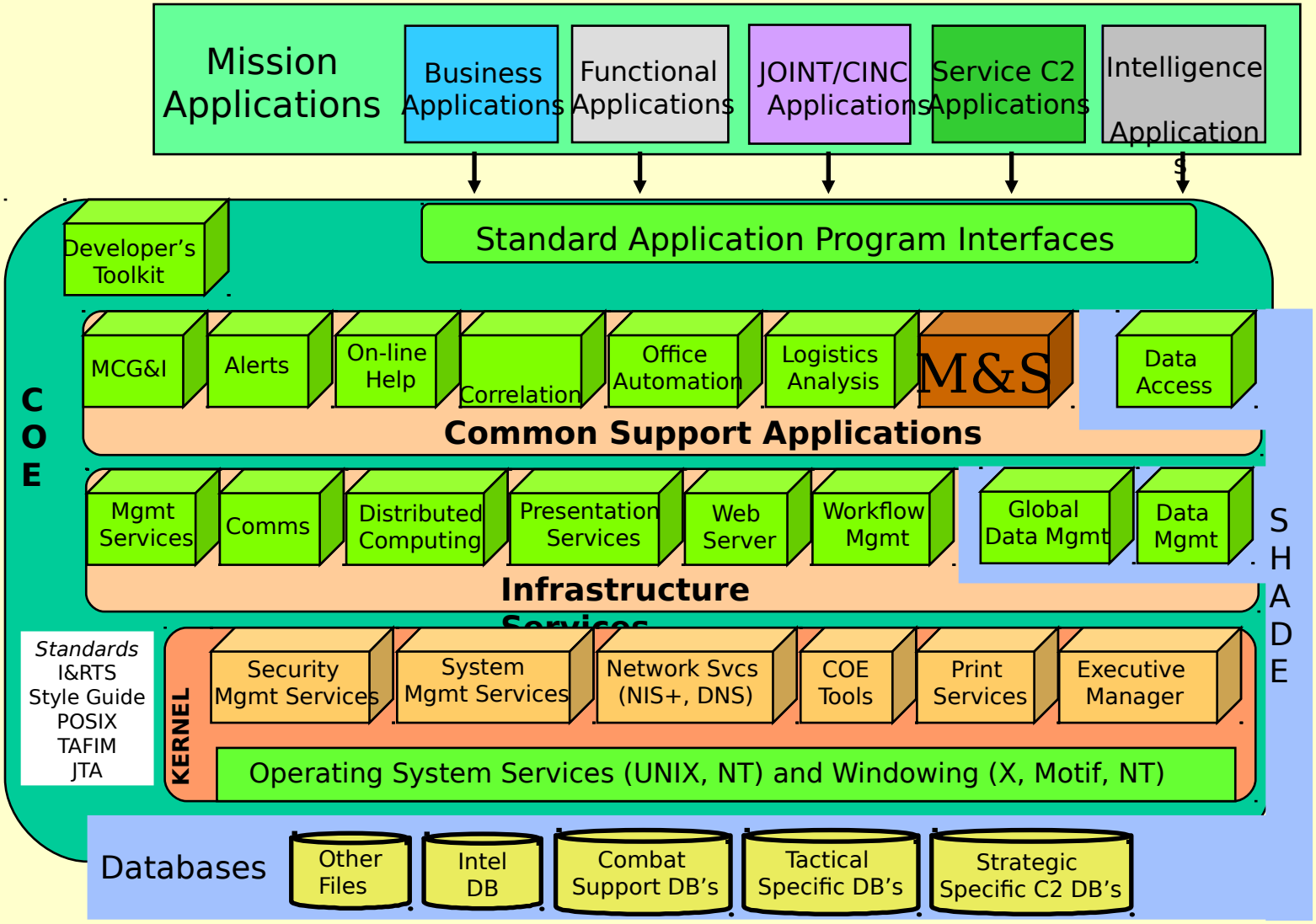
Embedded Simulation Infrastructure

HLA
(Interoperability)

Legacy
(Interfaces)

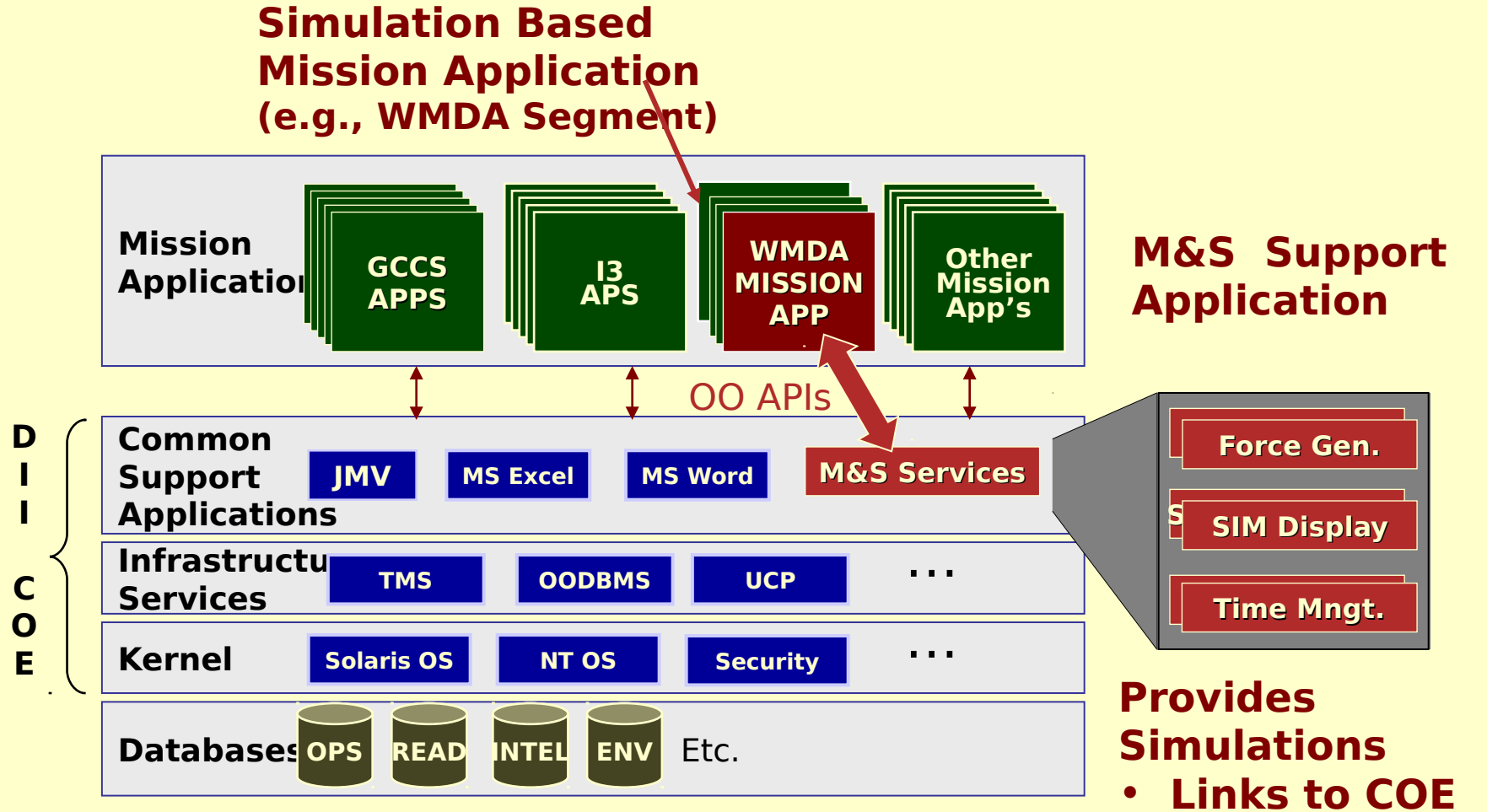


DII COE Architecture



M & S Integrated into the DII COE

Embedded Simulation Infrastructure

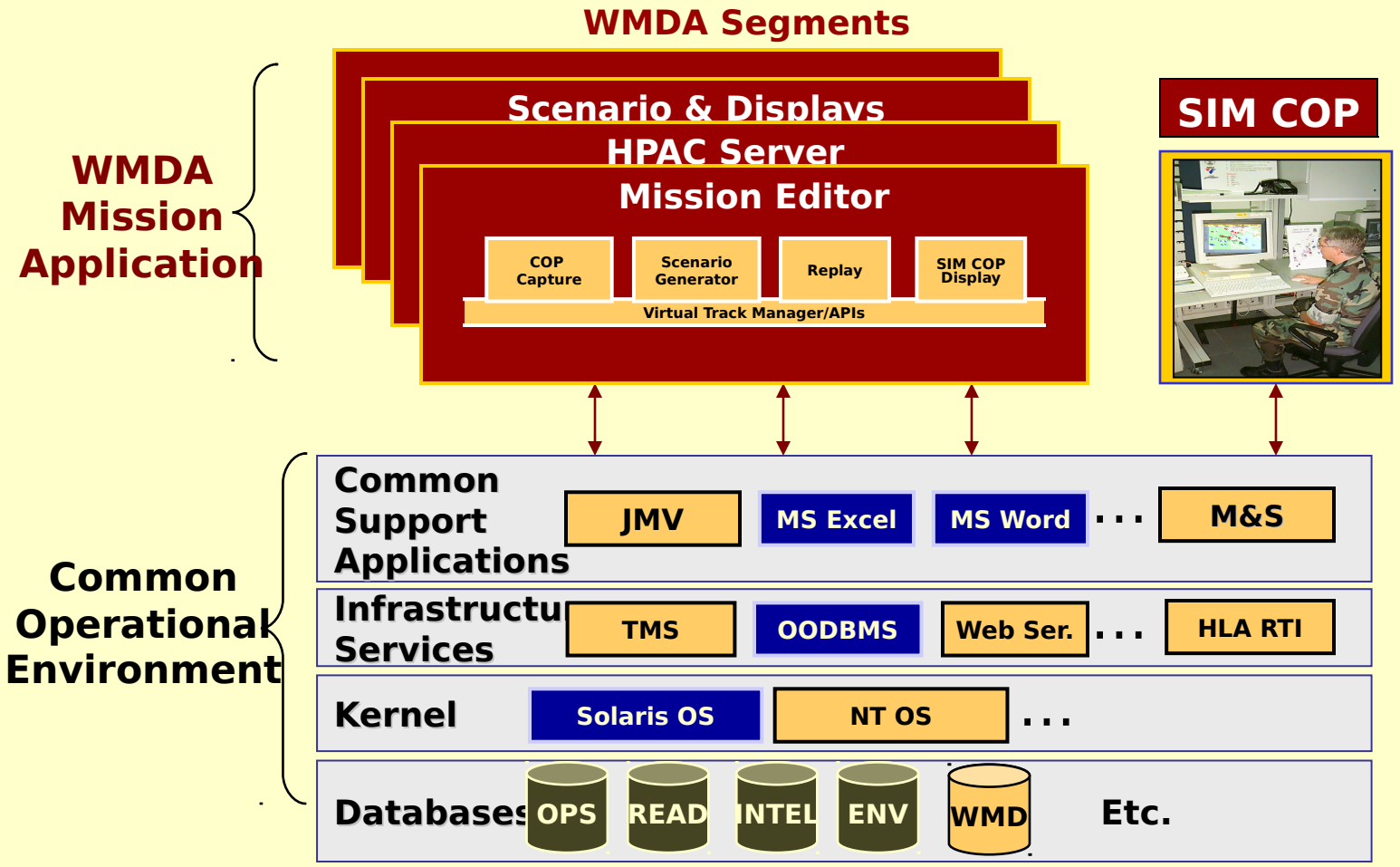


Provides Simulations

- **Links to COE**
- **M&S Services**
- **Tactical**

WMDA Mission Application

Complies with COE Architecture



"XXXX" - Primary COE Services used by WMDA

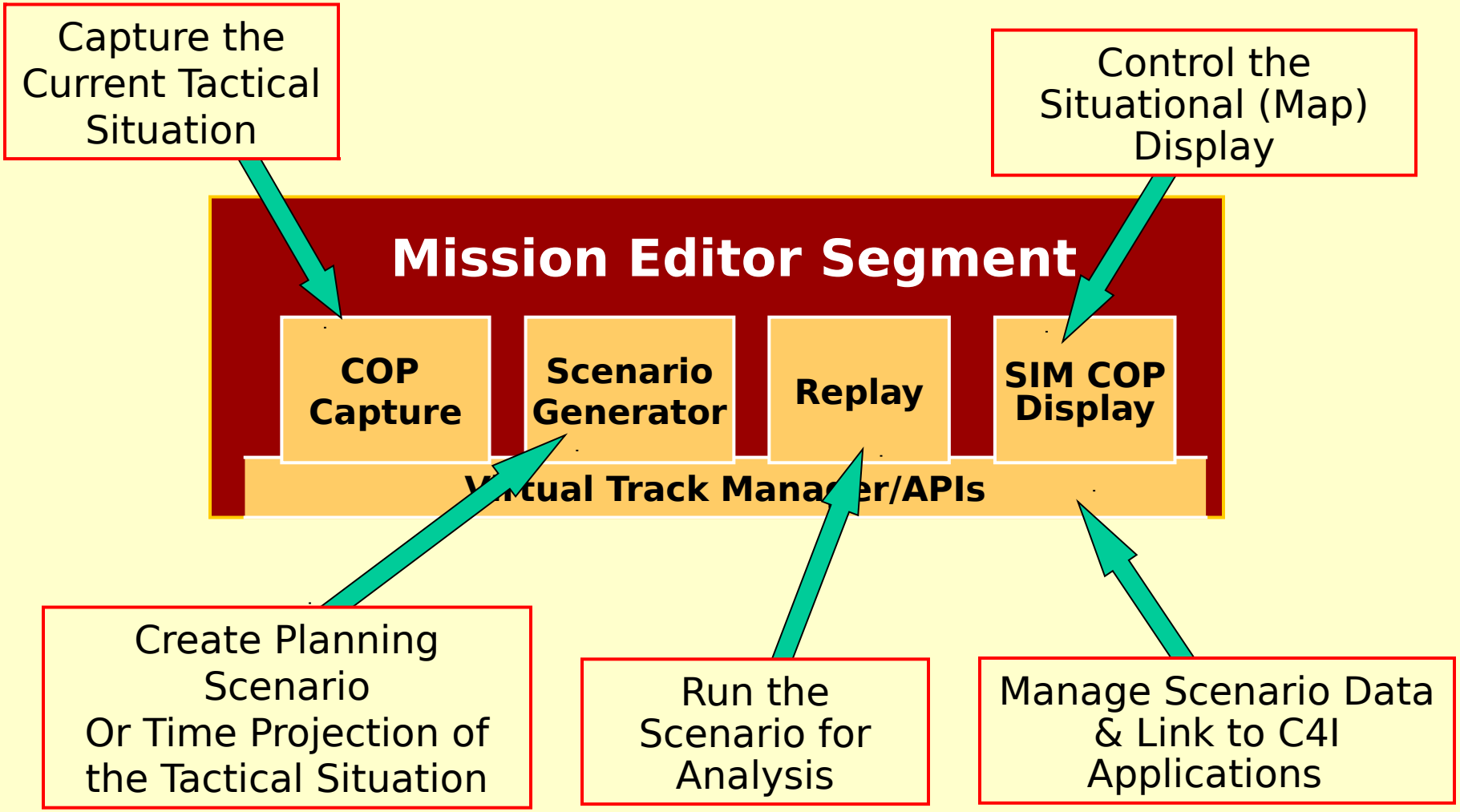
Example Segment: Mission Editor

Requirements

- **Create & Manage Scenarios**
  - US, Threat, & Others
  - Real, Slower & Faster than real time operations
- **Represents Physical Environments**
  - Sea, Undersea, Air, Land, Space
- **Use Common Data, Standardized Models**
  - TMS data structures
  - Messages (e.g., OTH Gold)
- **Connect Synthetic Battle Forces to GCCS Applications**
  - DII COE Services
  - Mission Applications

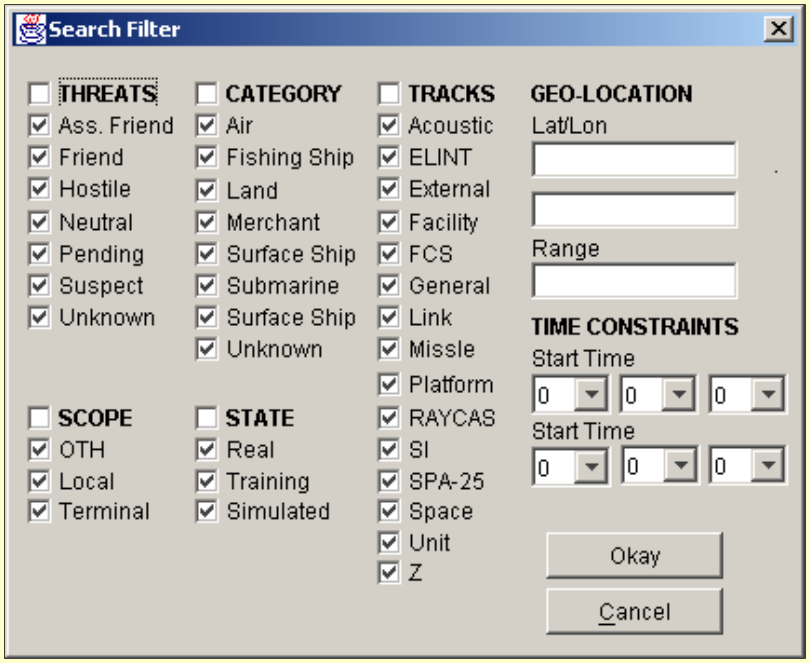
Mission Editor Segment

Reusable M&S Services


Capture the Current Tactical Situation
Control the Situational (Map) Display
Mission Editor Segment
COP Capture
Scenario Generator
Replay
SIM COP Display
Virtual Track Manager/APIs
Create Planning Scenario Or Time Projection of the Tactical Situation
Run the Scenario for Analysis
Manage Scenario Data & Link to C4I Applications

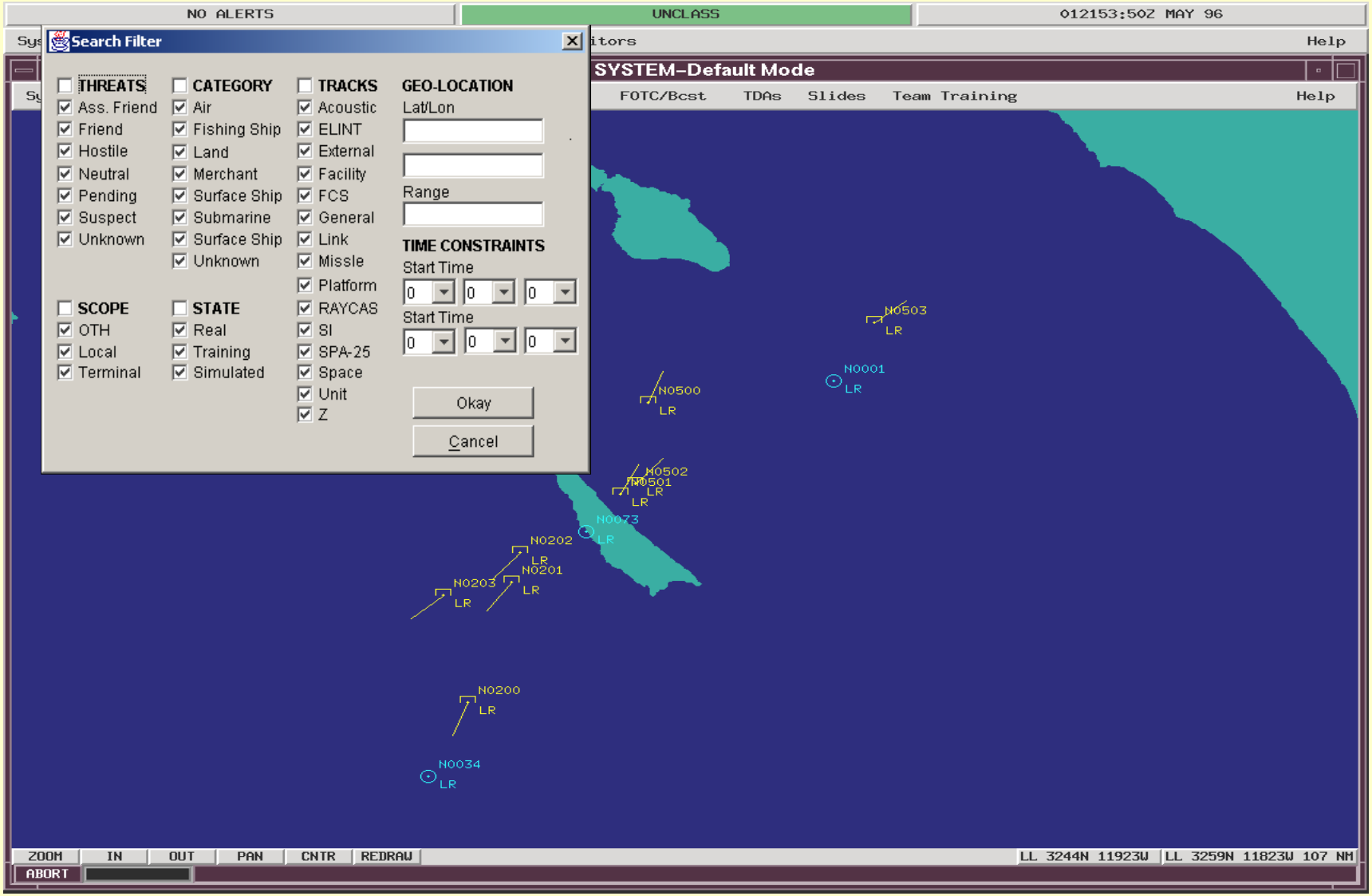
COP Capture
M&S Service

Purpose: capture real world tracks and provide them to an application.



- Select Tracks of Interest (Forces, Platforms, Track Types, etc).
- Select geographic location (lat/long and circumference area).
- Extract data from TMS.
- Set DTG.
- Provide to an Application as:
  - Simulated Tracks Objects (TMS-4 objects).

COP Capture


NO ALERTS
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Platform
RAYCAS
SI
SPA-25
Space
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Lat/Lon
Range
TIME CONSTRAINTS
Start Time
Start Time
Okay
Cancel
SCOPE
OTH
Local
Terminal
STATE
Real
Training
Simulated
SYSTEM–Default Mode
FOTC/Bcst
TDAs
Slides
Team Training
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N0503
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ZOOM
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PAN
CNTR
REDRAW
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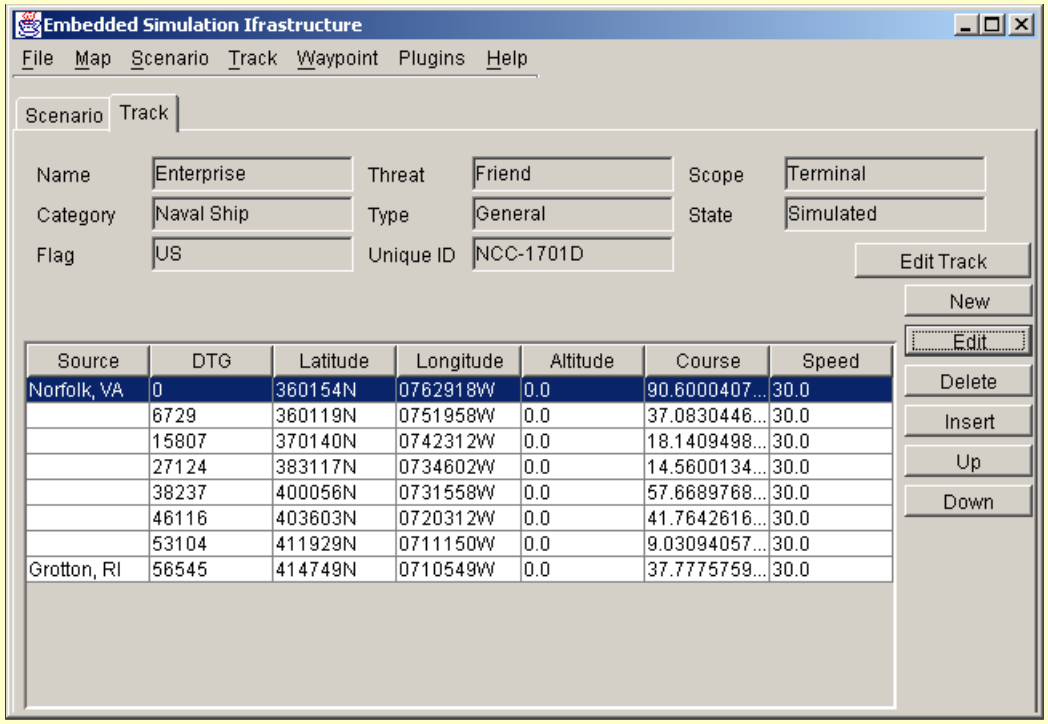
LL 3259N 11823W 107 NM
ABORT

Scenario Generator (M&S Service)

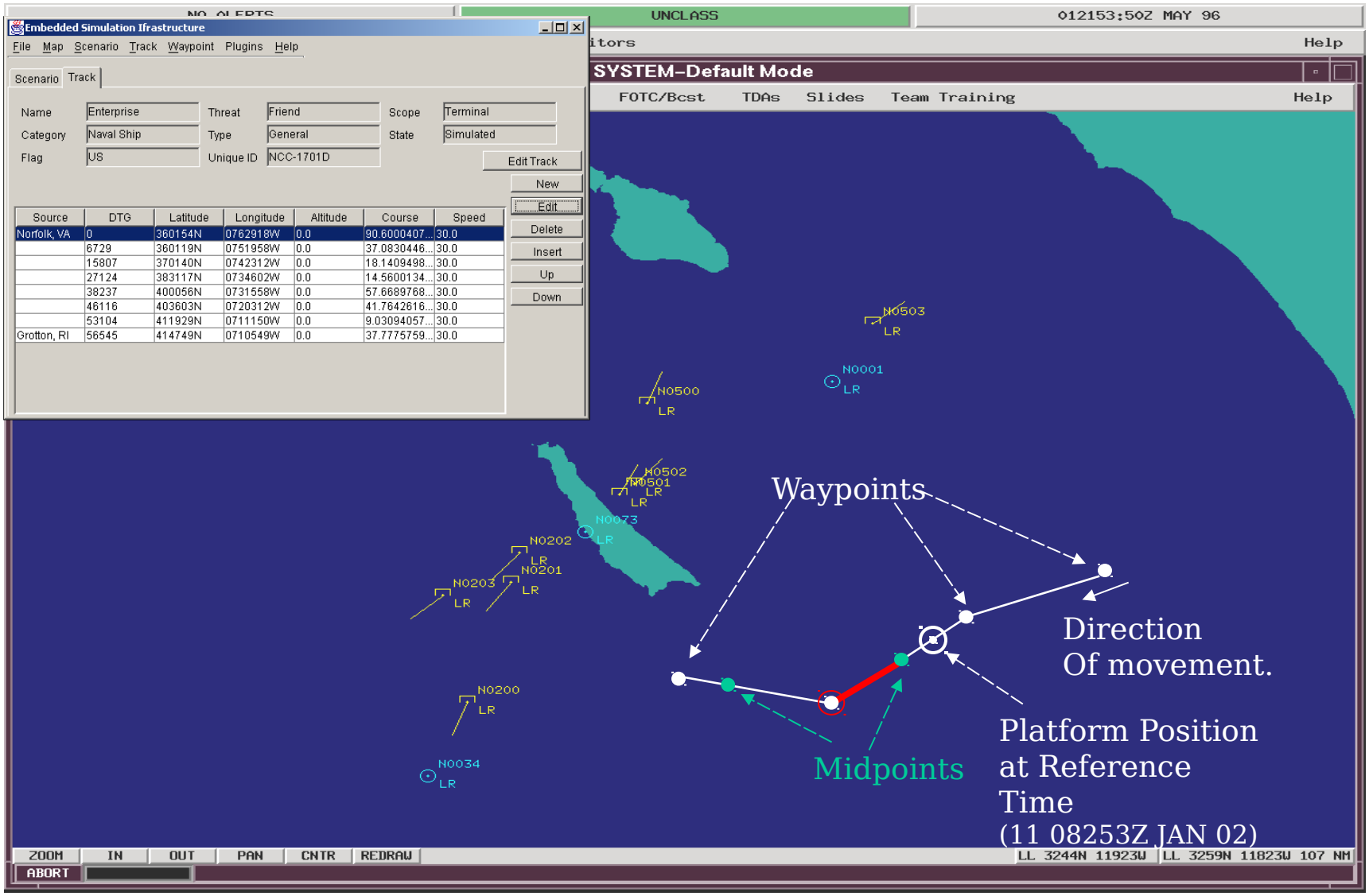
Purpose: create simulated tracks and/or enter track waypoint positions and dynamics into the scenario.



Ease of Use:

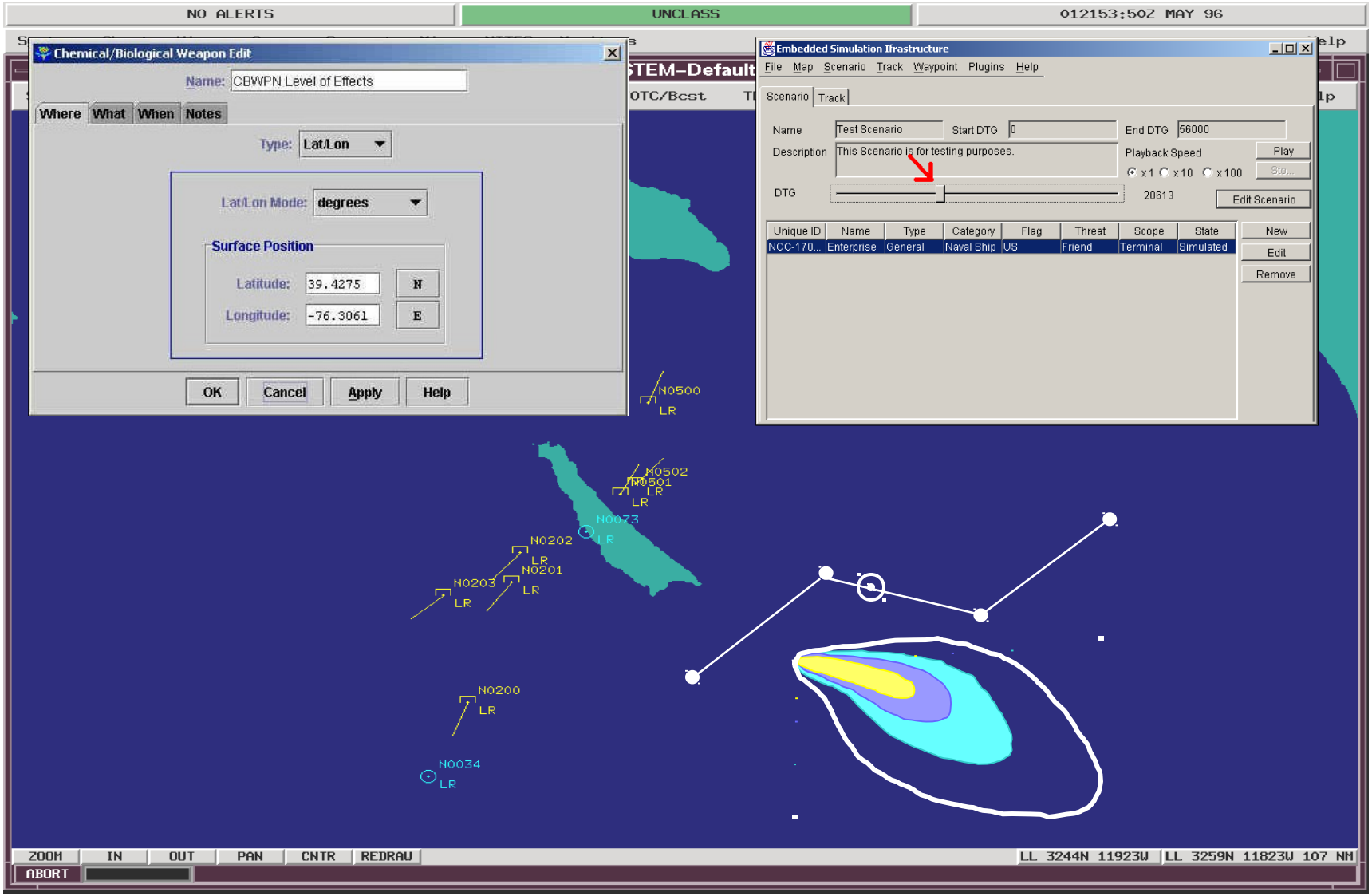
- Select the Platform/unit type.
- Enter lat/long. or click on the map.
- Point & Click to enter/modify waypoints.
- Add speeds, altitudes, rate of climb/descent, etc.

Scenario Generation



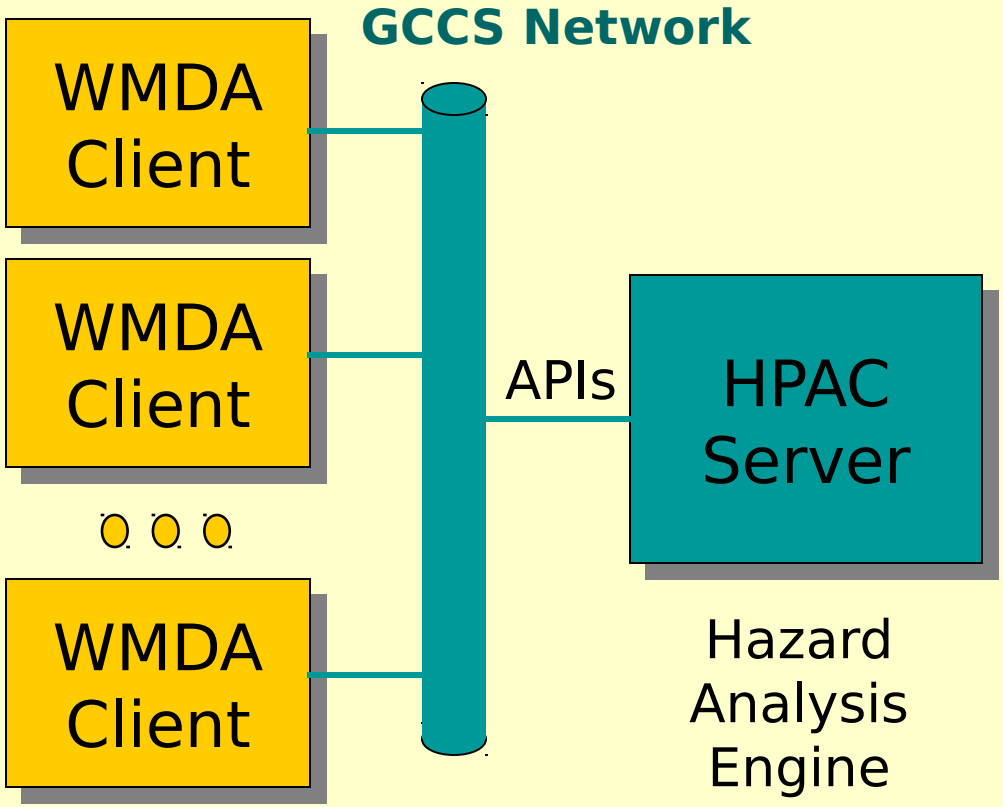
Integrating the Hazard Prediction Analysis Simulation In GCCS

WMDA Mission Application (Concept)



GCCS Client Server Architecture

The HPAC Server will be accessed over the GCCS network to provide a accurate CNB solution to distributed C4I Clients.



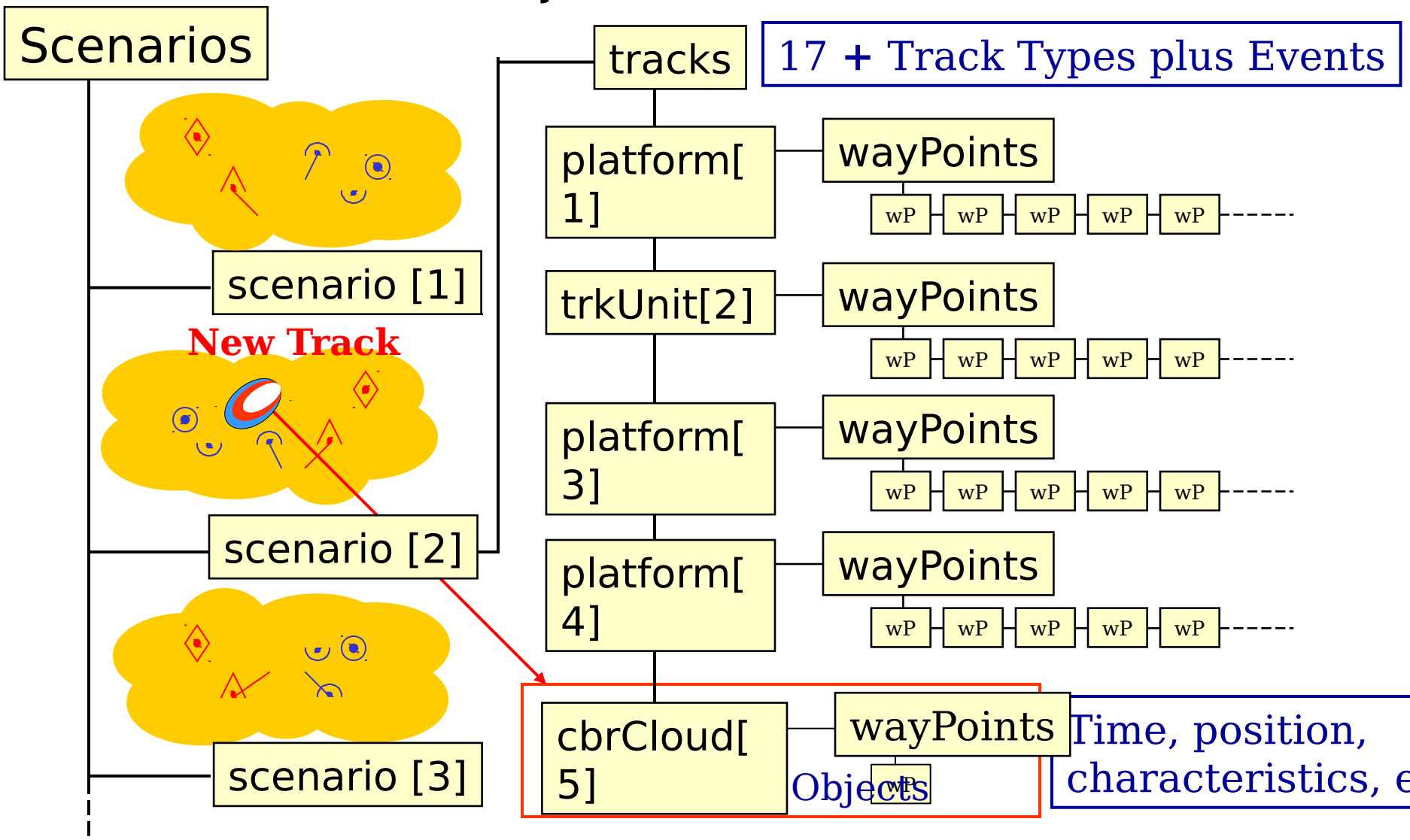
Summary

The ESI Program Products

- An established Embedded Simulation Architecture, used in C4I Applications:
  - WMDA Mission Application
  - Embedded Training
  - Reconstruction Segment
  - Others
- Initial WMDA Mission Application capability planned for FY/CY 02.

End
(Backup)

M&S Service: Virtual Track Manager



VTM Classes & Methods (Designer's APIs)

- **File Management** **Stores and retrieves scenario objects**
  - New, Open, Close, Save, Save as.., Send to .., Properties.
- **Track Storage** **Dynamic structure to store/access scenario objects**
  - ScenarioList — Contains a list of all the scenarios stored in files.
  - Scenario — Oject that contains information about a particular scenario.
  - TrackList — List of tracks in a particular scenario.
  - Track — A single track from the TrackList
  - WayPointList — List of WayPoints associated with a track.
  - WayPoint — Individual waypoint
  - TrackPlatform — Platform type of track (subclass of Track).
  - TrackUnit — Unit type of track (subclass of Track).
- **Track Management** **Methods to modify scenarios.**
  - SelectTrack — Click on track position, start or end points.
  - FindLocation — Progress along the PIM.
  - AddWayPoint — Add a waypoint at the end.
  - DeleteWayPoint — Delete highlighted waypoint.
  - InsertWayPoint — Insert midway between highlighted and next waypoint.
  - EditWayPoint — Modify bearing, altitude, latitude, longitude
  - EditTrack — Modify time of all waypoints